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Food web ecology of *Citharichthys arctifrons*, Gulf Stream flounder in the northwest Atlantic

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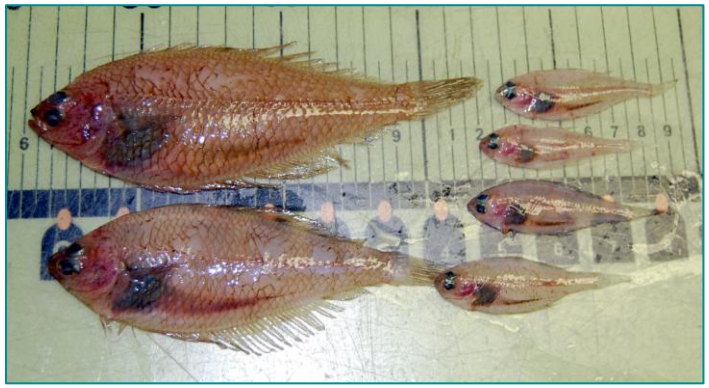
Rationale

- Widely distributed along the northeast U.S. continental shelf, regularly observed in fish diets, but lack commercial value.
- Diet was relatively unexamined except ~225 stomachs from the late 1970's.
- Small size (max ~ 18cm) and benthivorous diet make prey ID difficult.



Objectives

- Who's eating Gulf Stream flounder?
- What do Gulf Stream eat?
  - Seasonal, regional, and annual differences
- Are at-sea sampling methods of Gulf Stream stomach contents satisfactory?

Data

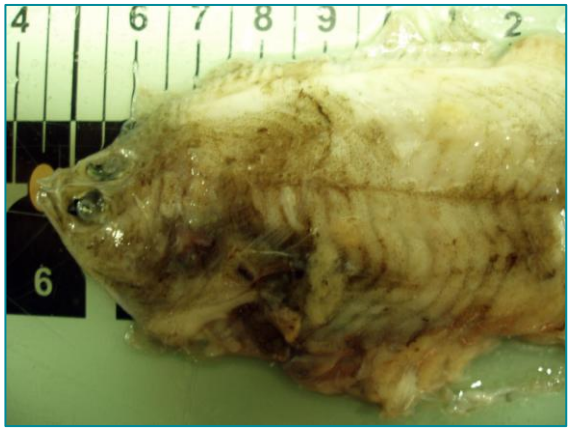
- 1973 to 2013 Food Habits Database consisting of > 600,000 stomachs from >150 fish predators.
- Gulf Stream Stomachs
  - 1976-1980
  - 2005-2010
    - Examined (macroscopically at sea)
    - Preserved (examined microscopically in lab)
  - 2011-2012 Preserved

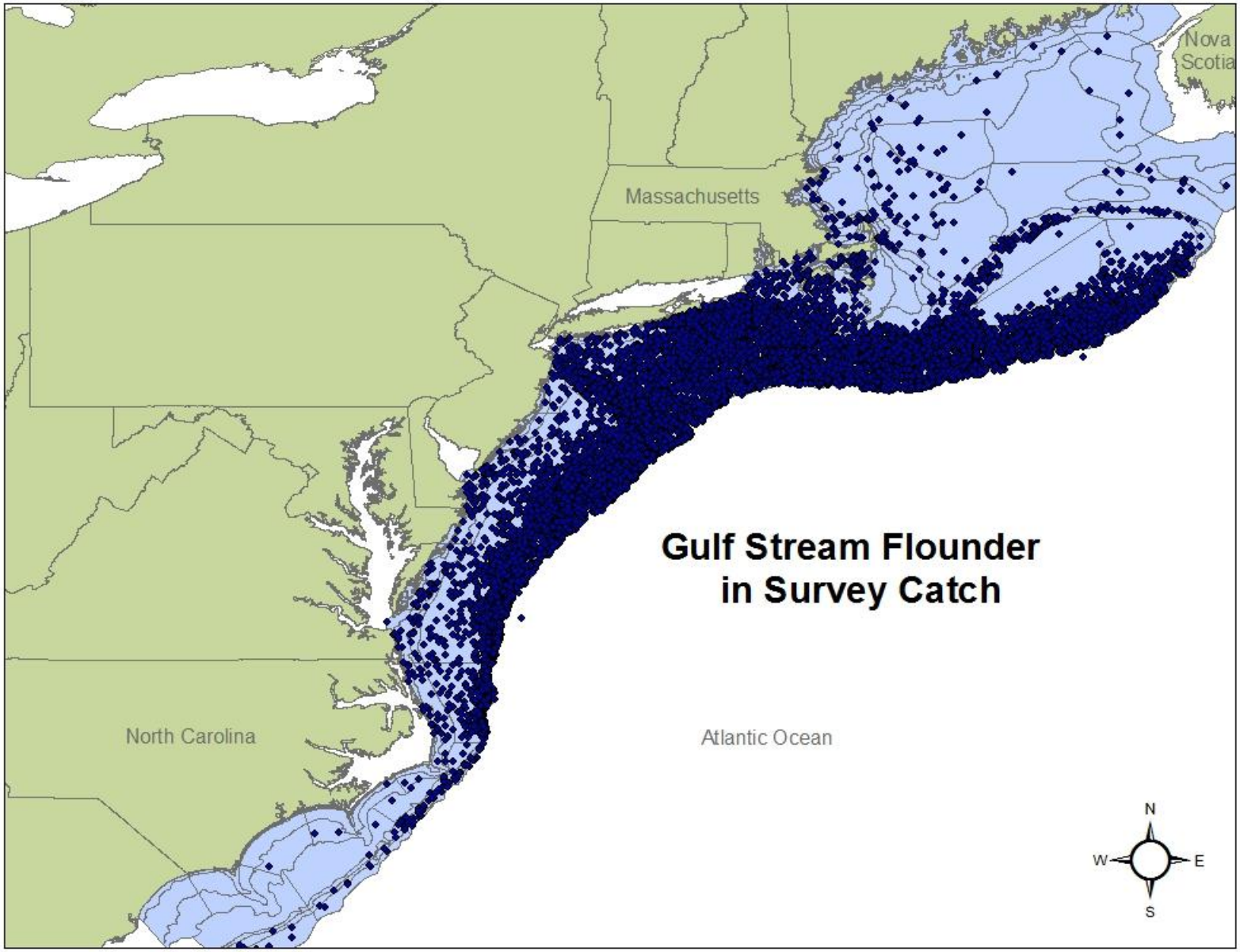

Nova Scotia
Massachusetts
North Carolina
Atlantic Ocean
Cape Hatteras
N
W
E
S

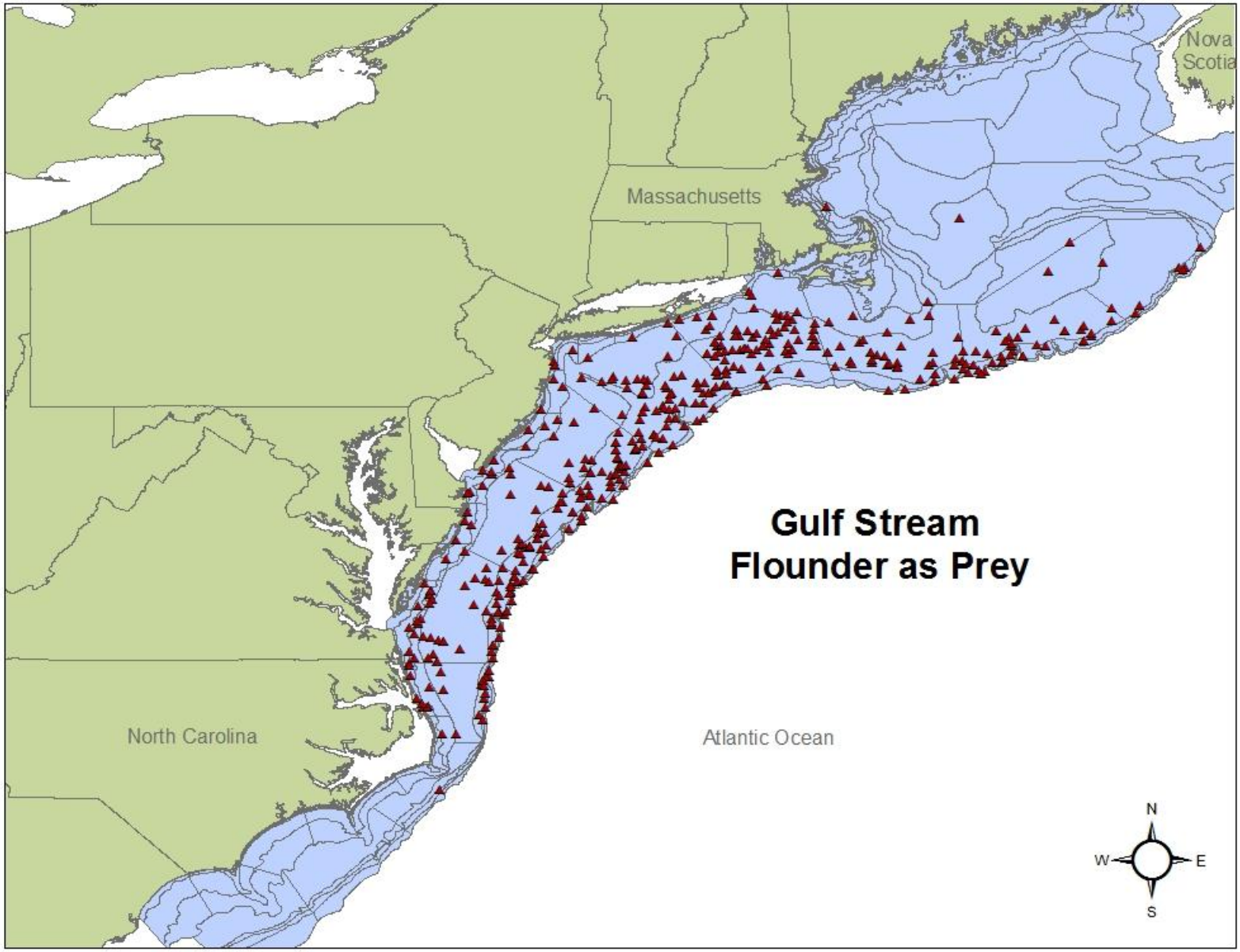
Who's eating Gulf Stream and how frequently?

Spiny Dogfish	82
Little Skate	79
Spotted Hake	64
Goosefish	44
Fourspot Flounder	38
Red Hake	27
Summer Flounder	22
Silver Hake	21
Windowpane Flounder	19
White Hake	14

Atlantic Cod	12
Smooth Dogfish	11
Winter Skate	8
Clearnose Skate	7
Barndoor Skate	6

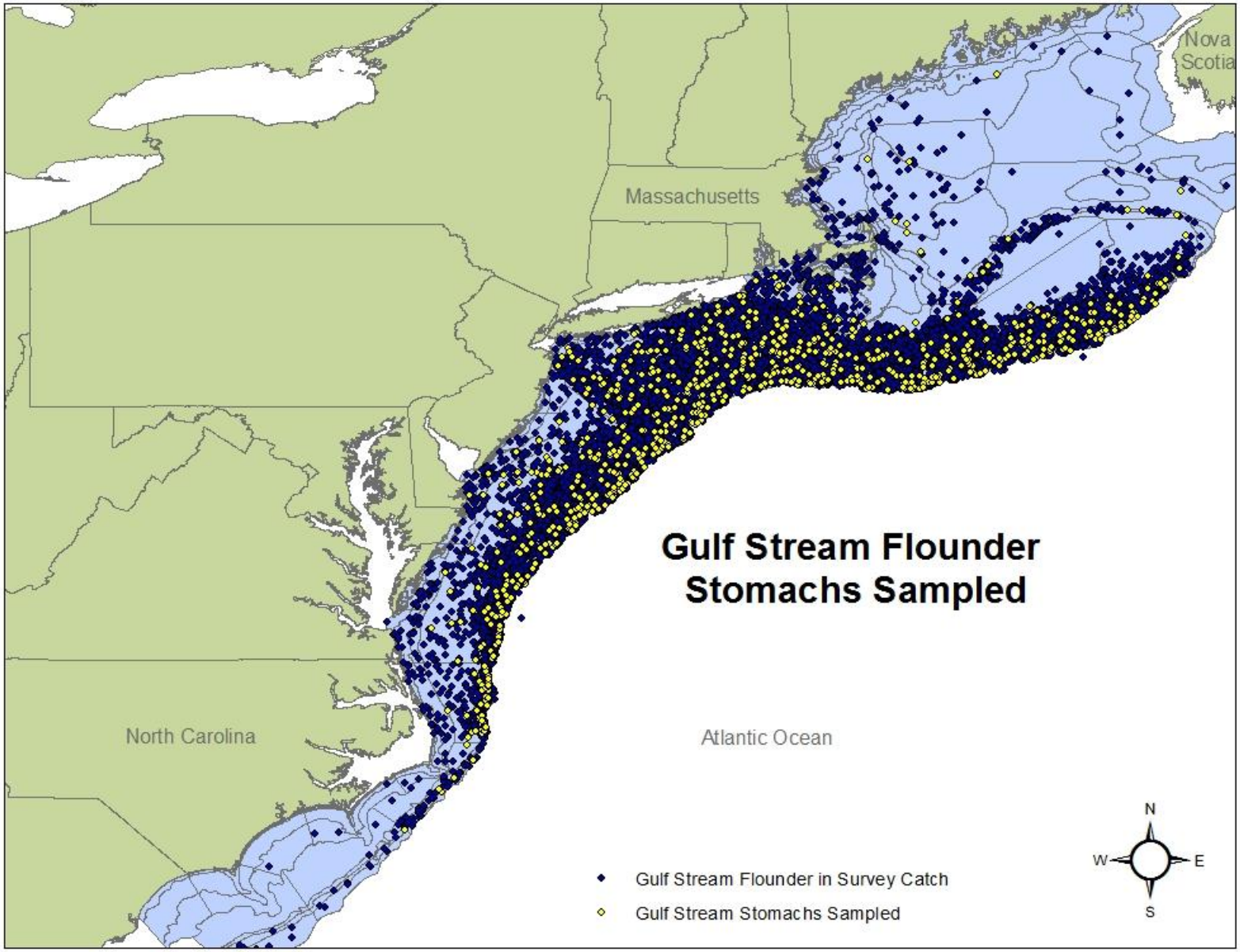



Nova Scotia
Massachusetts
Gulf Stream Flounder
in Survey Catch
North Carolina
Atlantic Ocean
N
W
E
S

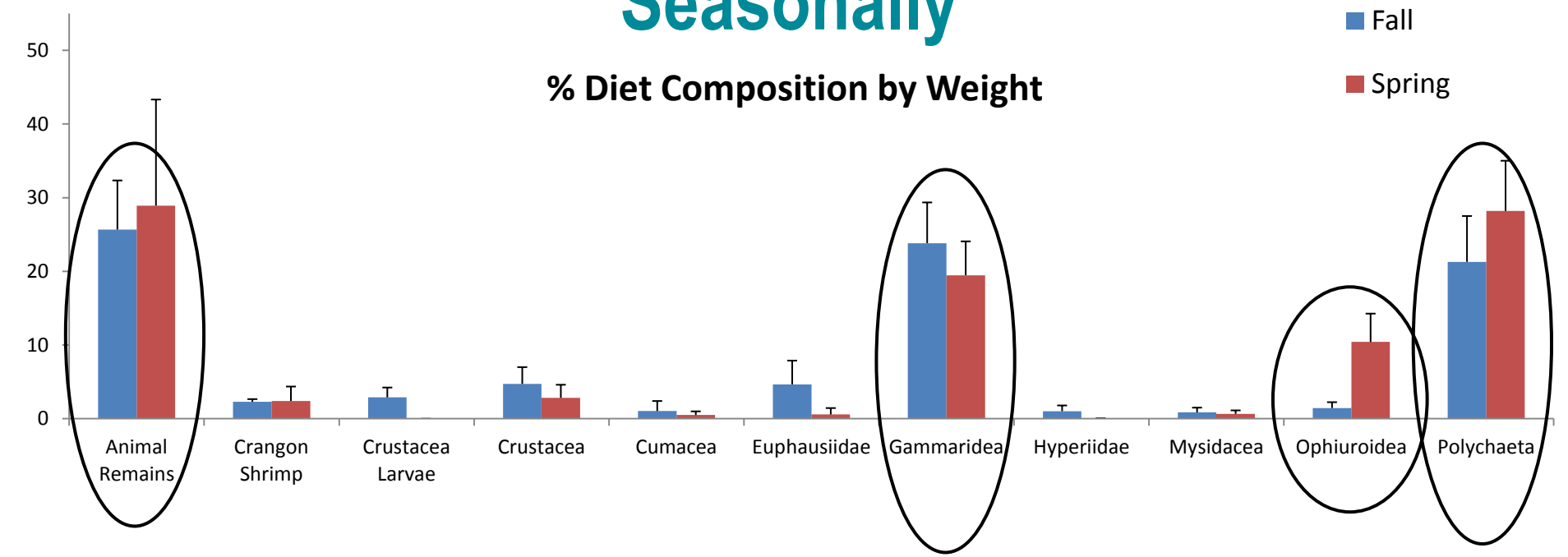

Nova Scotia
Massachusetts
Gulf Stream
Flounder as Prey
North Carolina
Atlantic Ocean
N
W
E
S

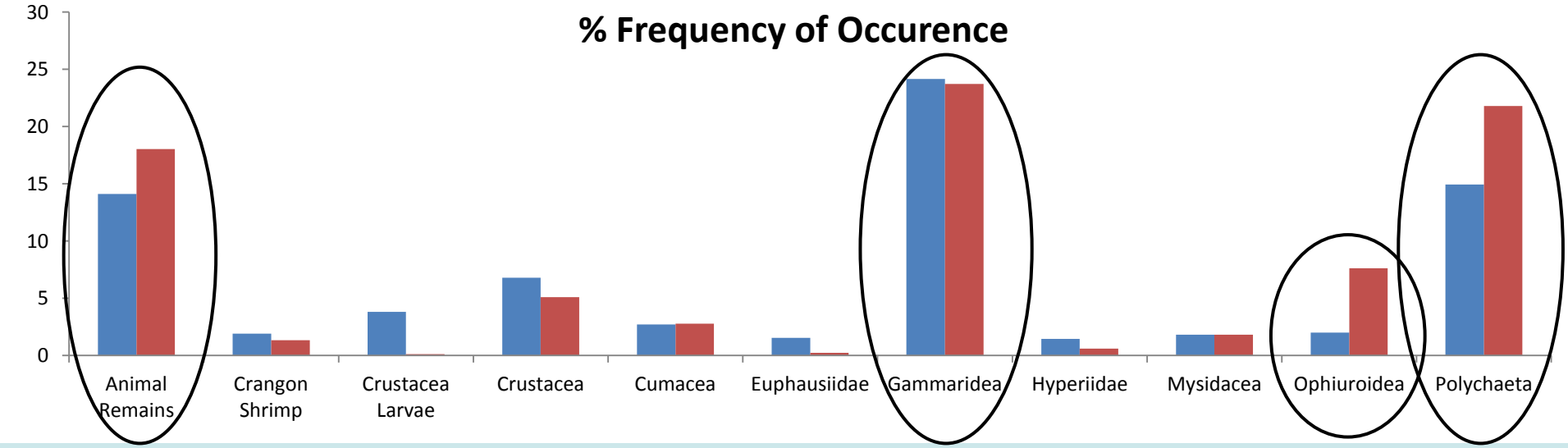
What do Gulf Stream Eat?

- Are there any seasonal, regional, or annual trends?
  - Diet indices
    - % diet by mass
    - % frequency of occurrence
- Where are Gulf Stream consuming their major prey?

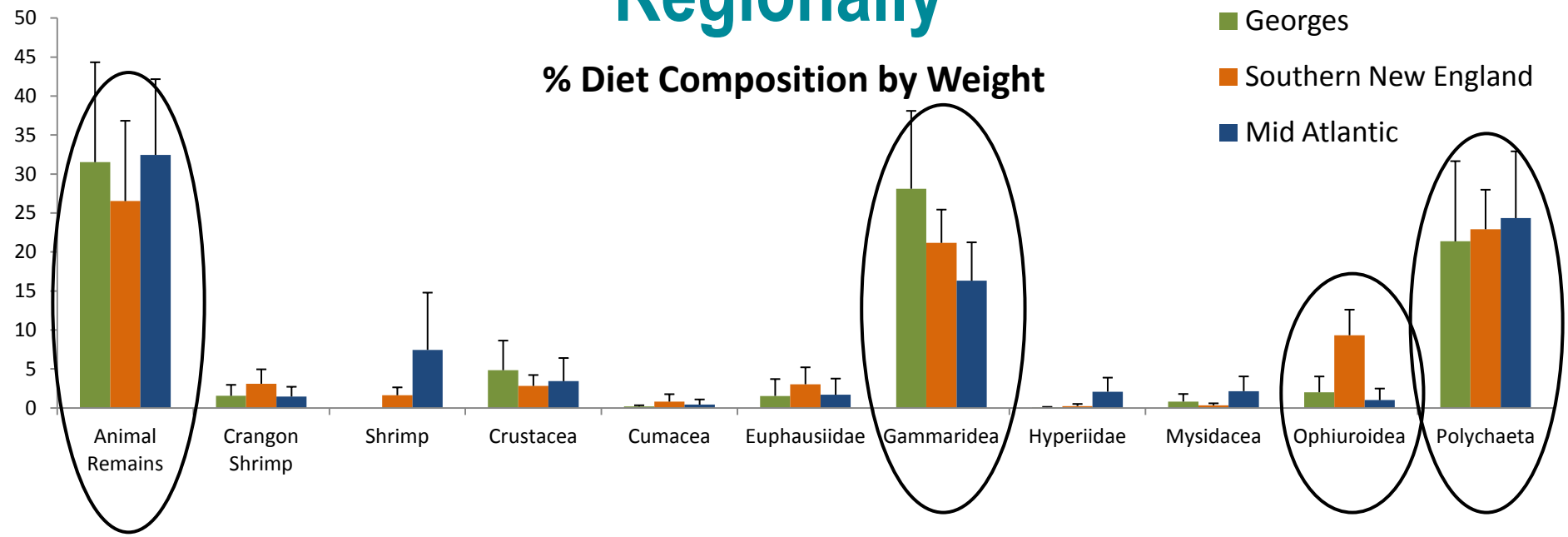

Nova Scotia
Massachusetts
North Carolina
Atlantic Ocean
Gulf Stream Flounder
Stomachs Sampled
N
W
E
S
Gulf Stream Flounder in Survey Catch
Gulf Stream Stomachs Sampled

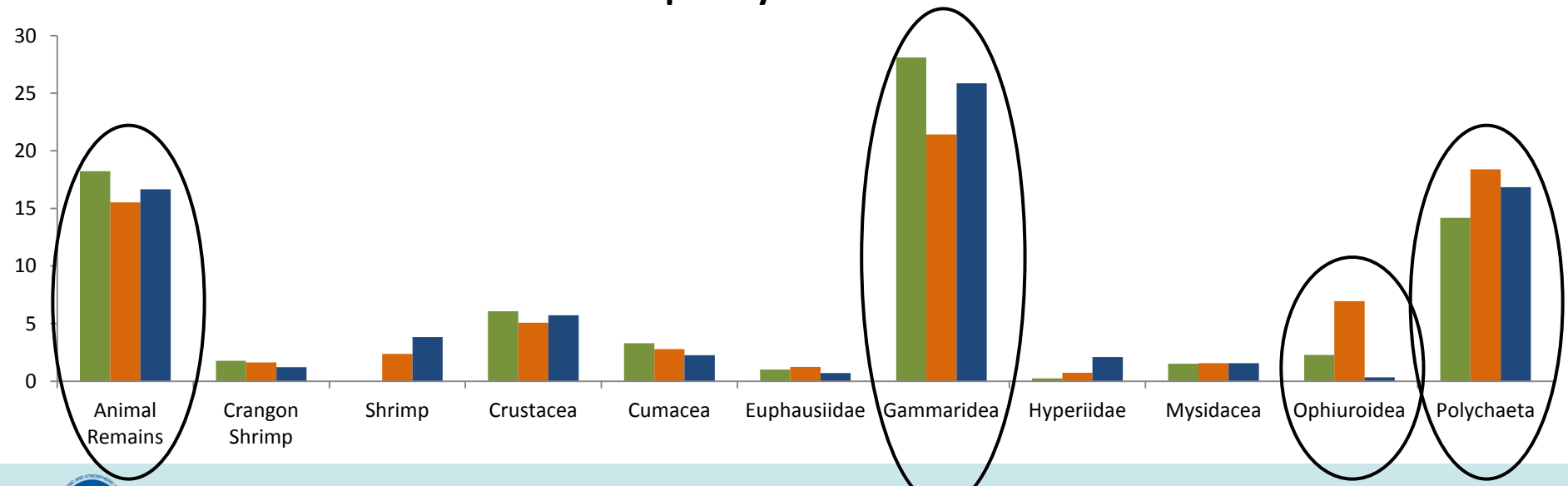
Seasonally


% Diet Composition by Weight
Fall
Spring
50
40
30
20
10
0
Animal Remains
Crangon Shrimp
Crustacea Larvae
Crustacea
Cumacea
Euphausiidae
Gammaridea
Hyperiidae
Mysidacea
Ophiuroidea
Polychaeta

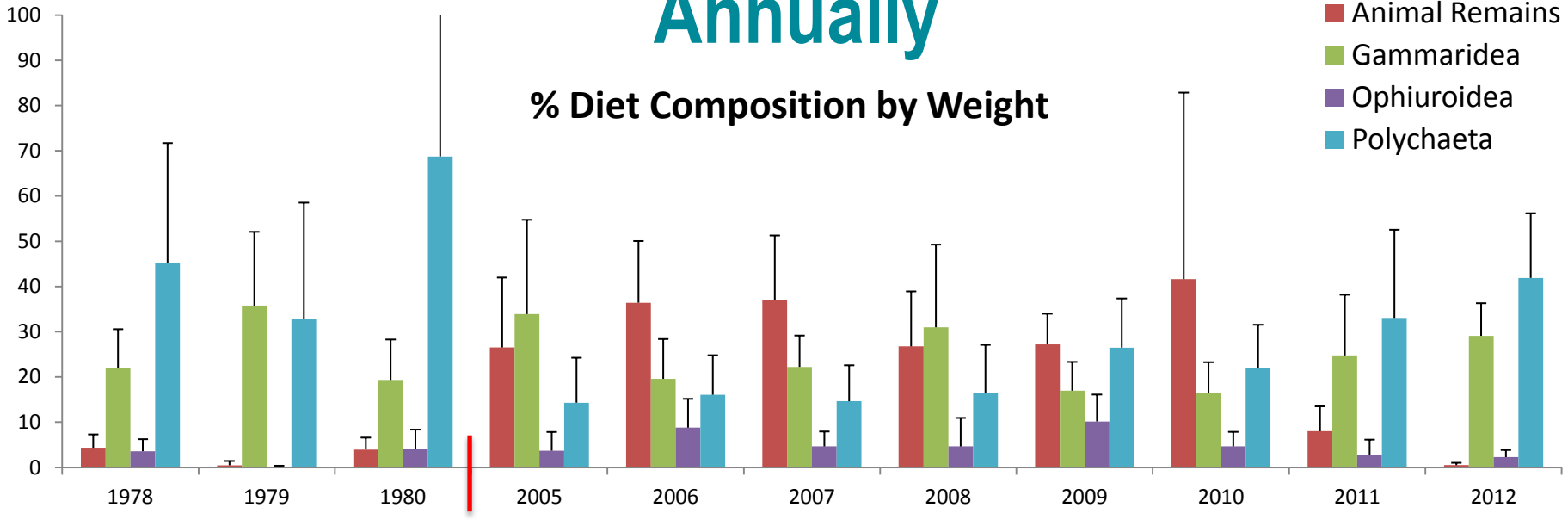

% Frequency of Occurence
30
25
20
15
10
5
0
Animal Remains
Crangon Shrimp
Crustacea Larvae
Crustacea
Cumacea
Euphausiidae
Gammaridea
Hyperiidae
Mysidacea
Ophiuroidea
Polychaeta

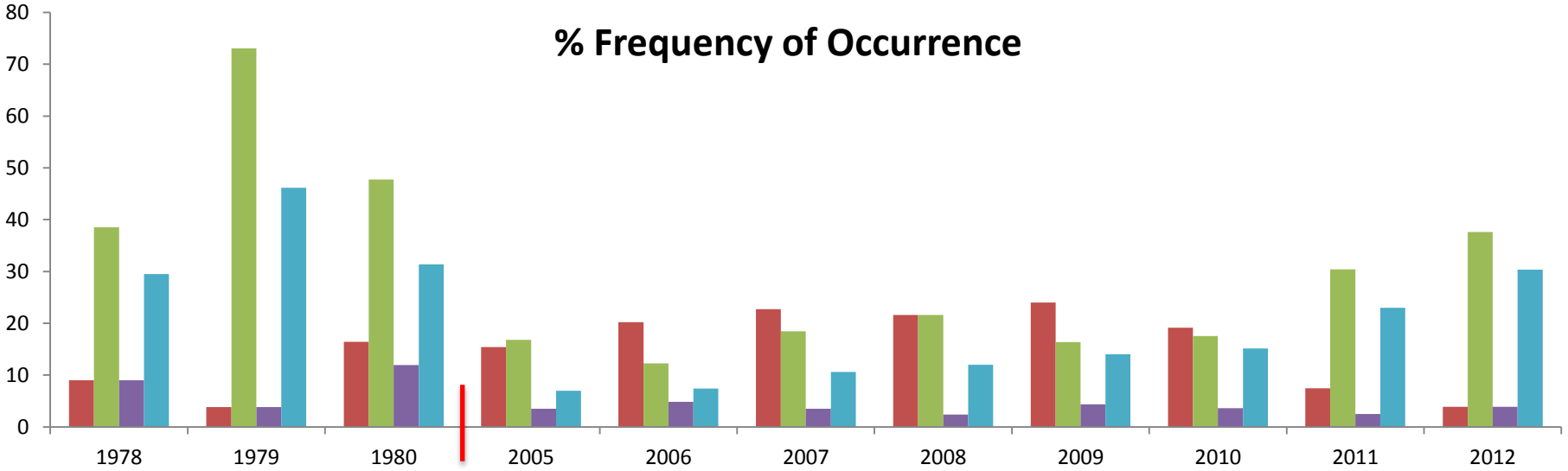
Regionally


% Diet Composition by Weight
Georges
Southern New England
Mid Atlantic
50
45
40
35
30
25
20
15
10
5
0
Animal Remains
Crangon Shrimp
Shrimp
Crustacea
Cumacea
Euphausiidae
Gammaridea
Hyperiidae
Mysidacea
Ophiuroidea
Polychaeta

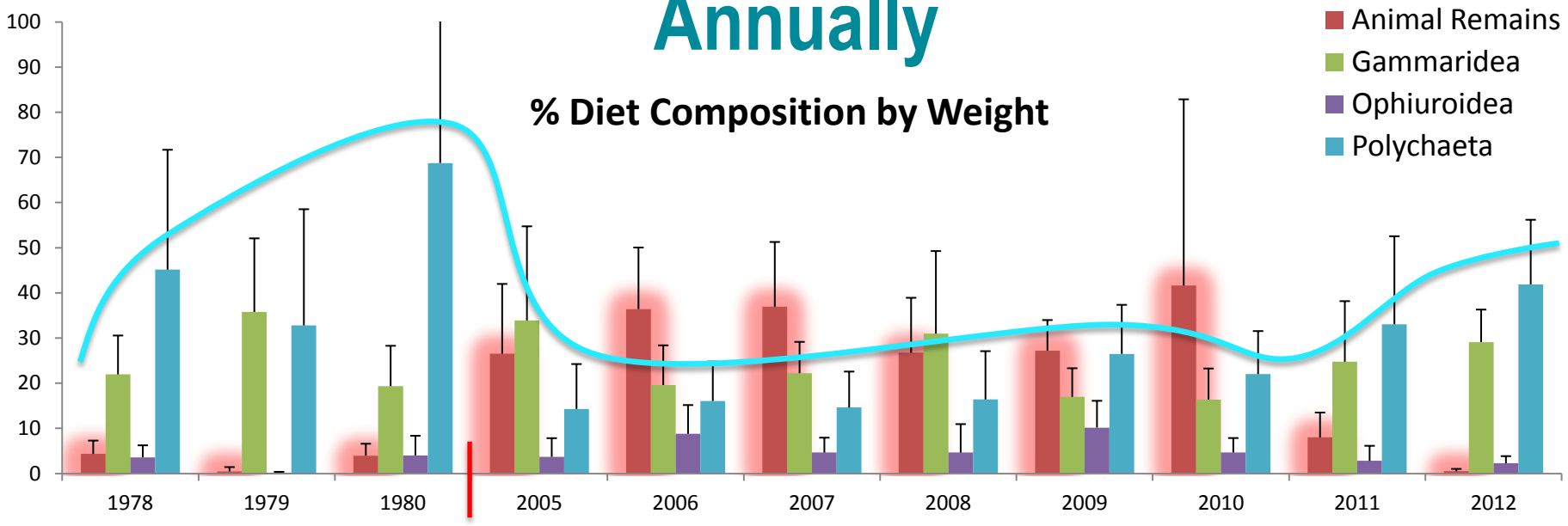

% Frequency of Occurrence
30
25
20
15
10
5
0
Animal Remains
Crangon Shrimp
Shrimp
Crustacea
Cumacea
Euphausiidae
Gammaridea
Hyperiidae
Mysidacea
Ophiuroidea
Polychaeta

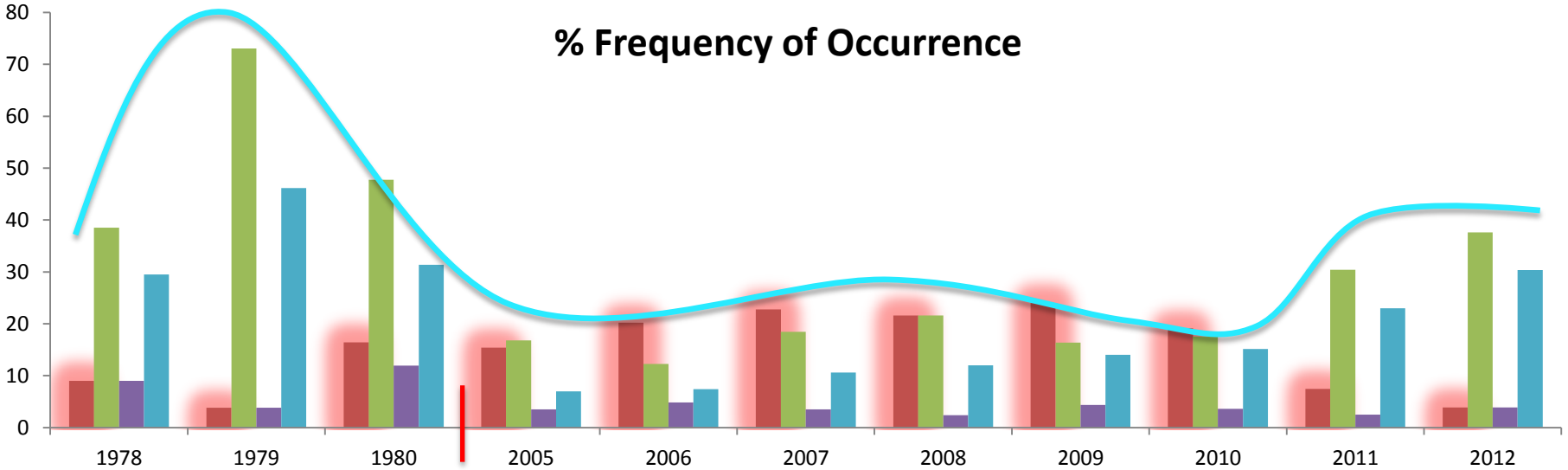
Annually

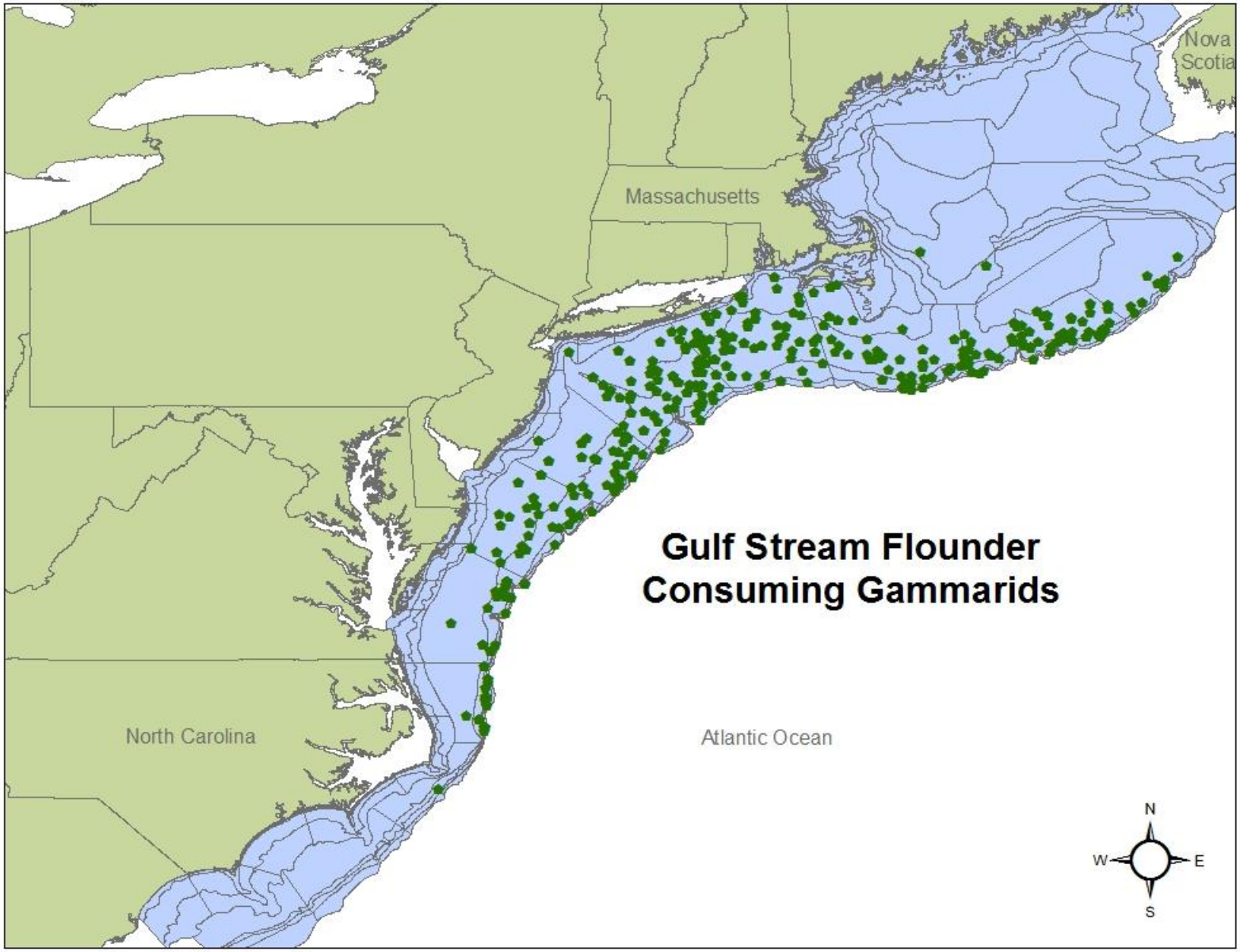

% Diet Composition by Weight
Animal Remains
Gammaridea
Ophiuroidea
Polychaeta
100
90
80
70
60
50
40
30
20
10
0
1978
1979
1980
2005
2006
2007
2008
2009
2010
2011
2012

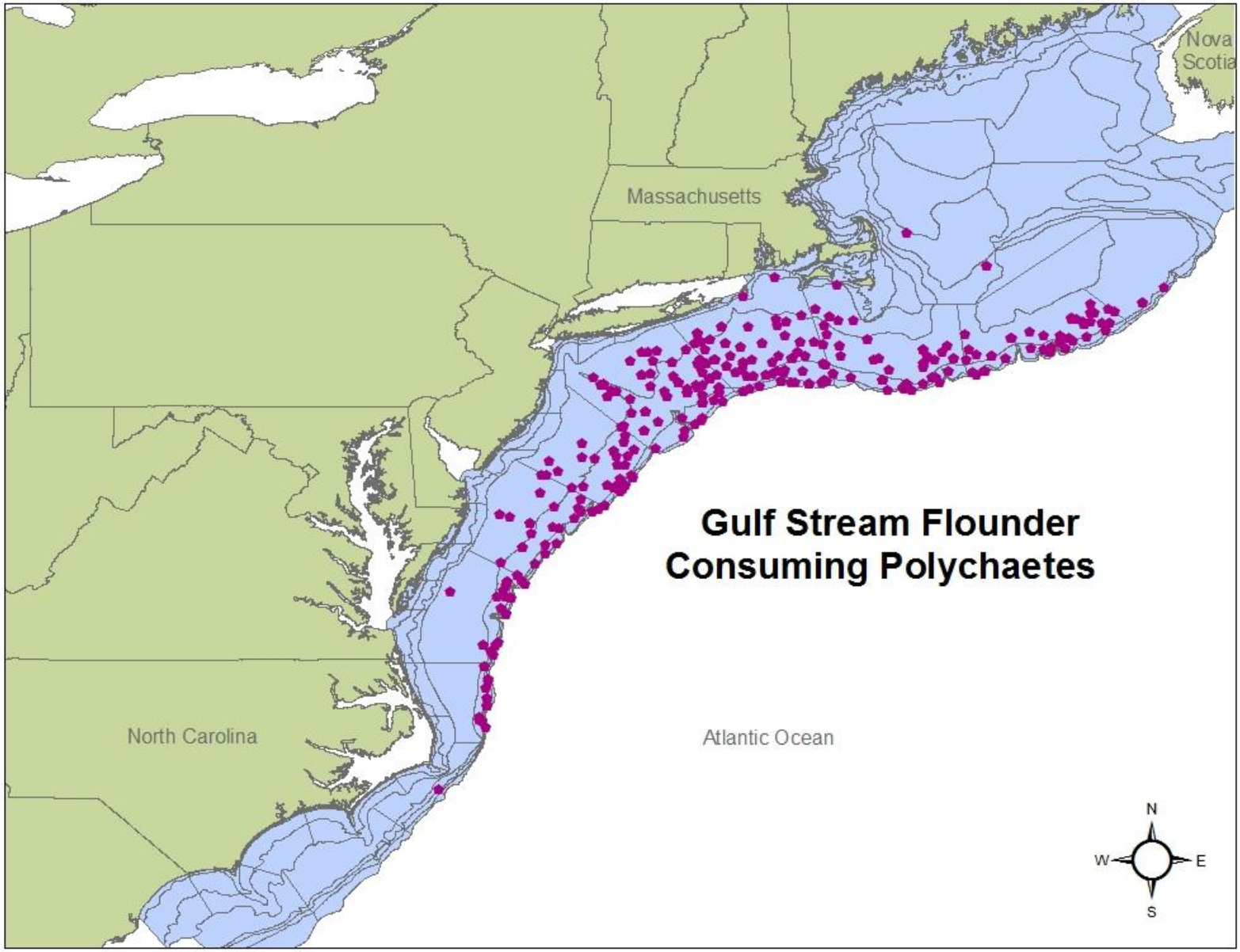

% Frequency of Occurrence
80
70
60
50
40
30
20
10
0
1978
1979
1980
2005
2006
2007
2008
2009
2010
2011
2012

Annually


% Diet Composition by Weight
Animal Remains
Gammaridea
Ophiuroidea
Polychaeta
100
90
80
70
60
50
40
30
20
10
0
1978
1979
1980
2005
2006
2007
2008
2009
2010
2011
2012


% Frequency of Occurrence
80
70
60
50
40
30
20
10
0
1978
1979
1980
2005
2006
2007
2008
2009
2010
2011
2012


Nova Scotia
Massachusetts
Gulf Stream Flounder
Consuming Gammarids
North Carolina
Atlantic Ocean
N
W
E
S

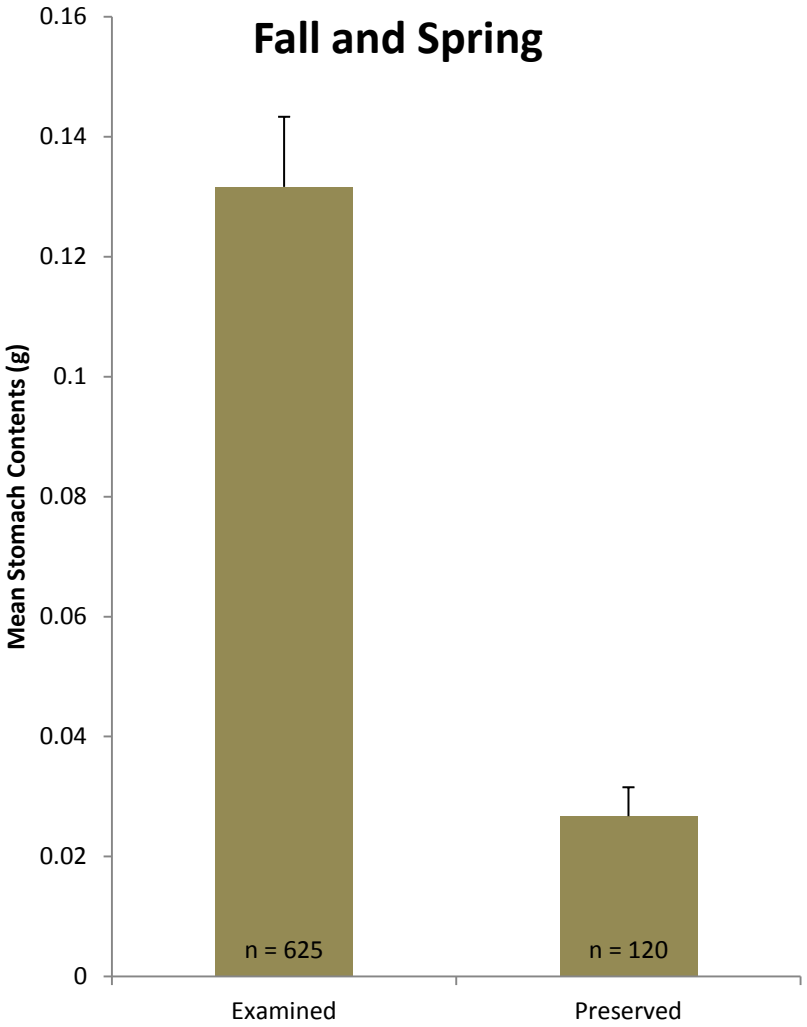

Nova Scotia
Massachusetts
Gulf Stream Flounder
Consuming Polychaetes
North Carolina
Atlantic Ocean
N
W
E
S

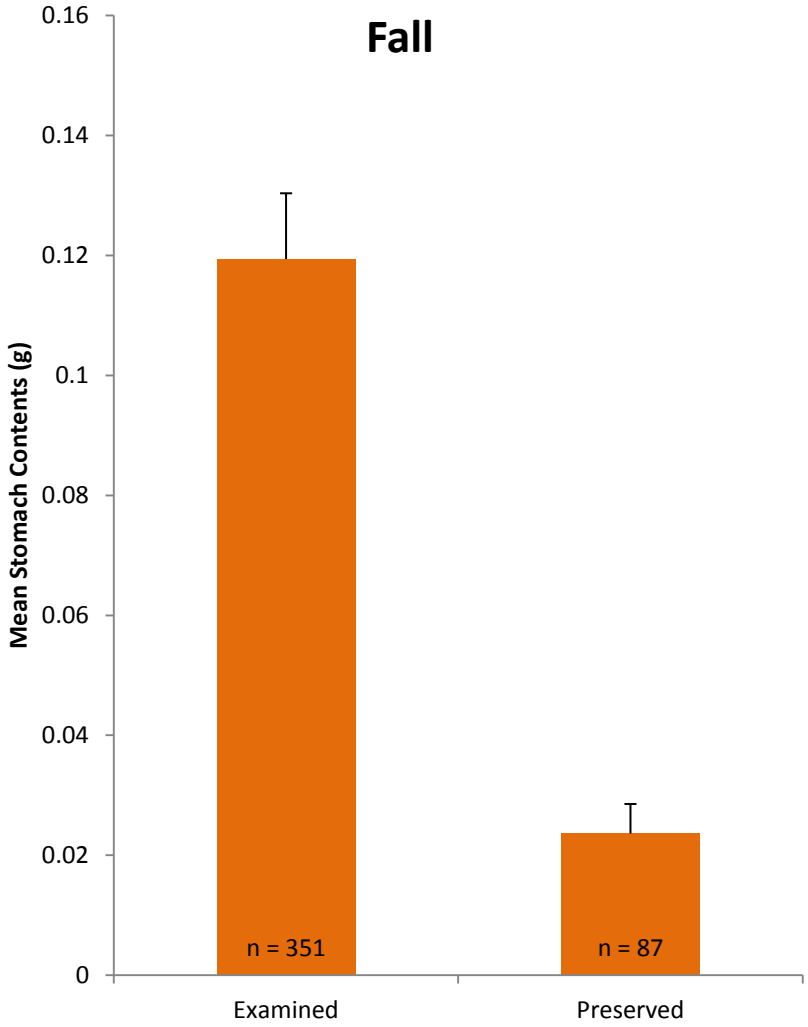

Nova Scotia
Massachusetts
Gulf Stream Flounder
Consuming Brittle Stars
North Carolina
Atlantic Ocean
N
W
E
S

Macroscopic vs Microscopic Prey Analysis 2005 to 2010

- Volume Estimates – mean stomach contents
- Identification accuracy and taxonomic resolution
- Frequency of empty stomachs

Macro vs Micro Mean Stomach Contents

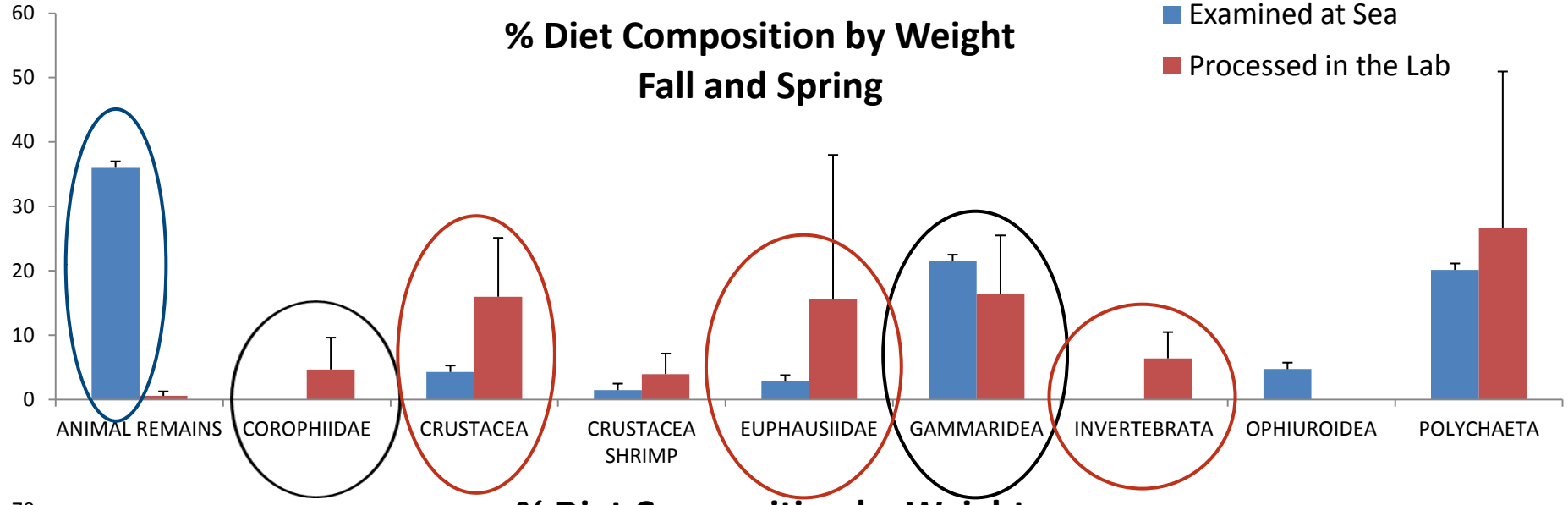


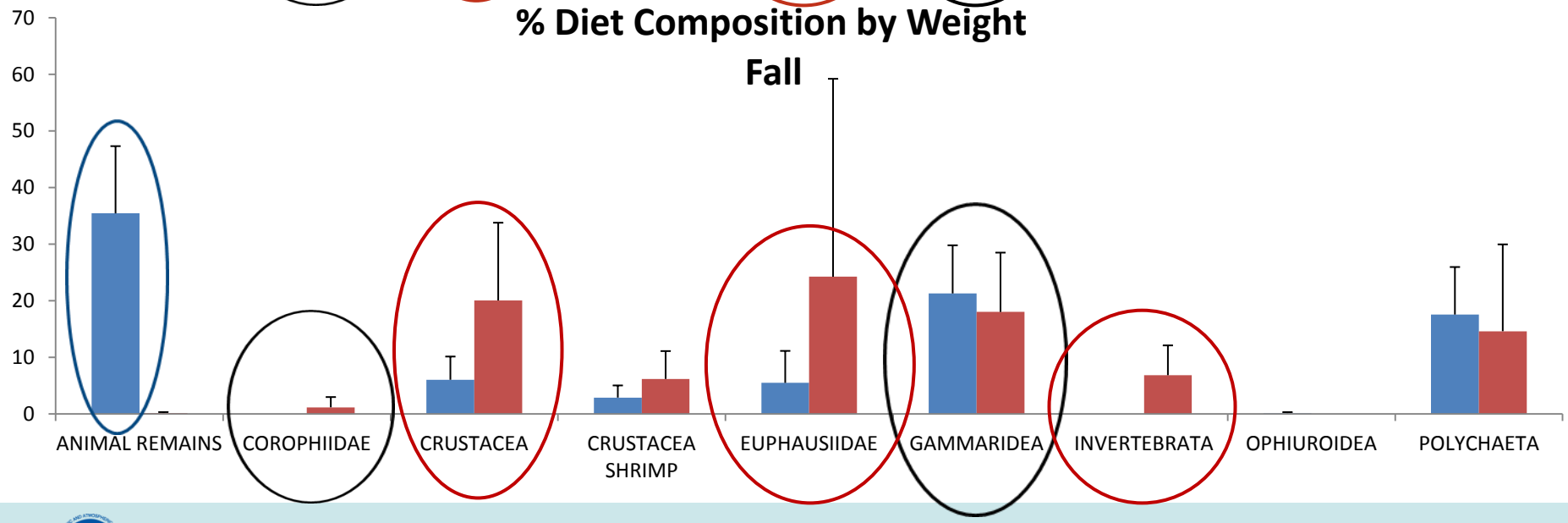


T-Test Results: p-value <0.001

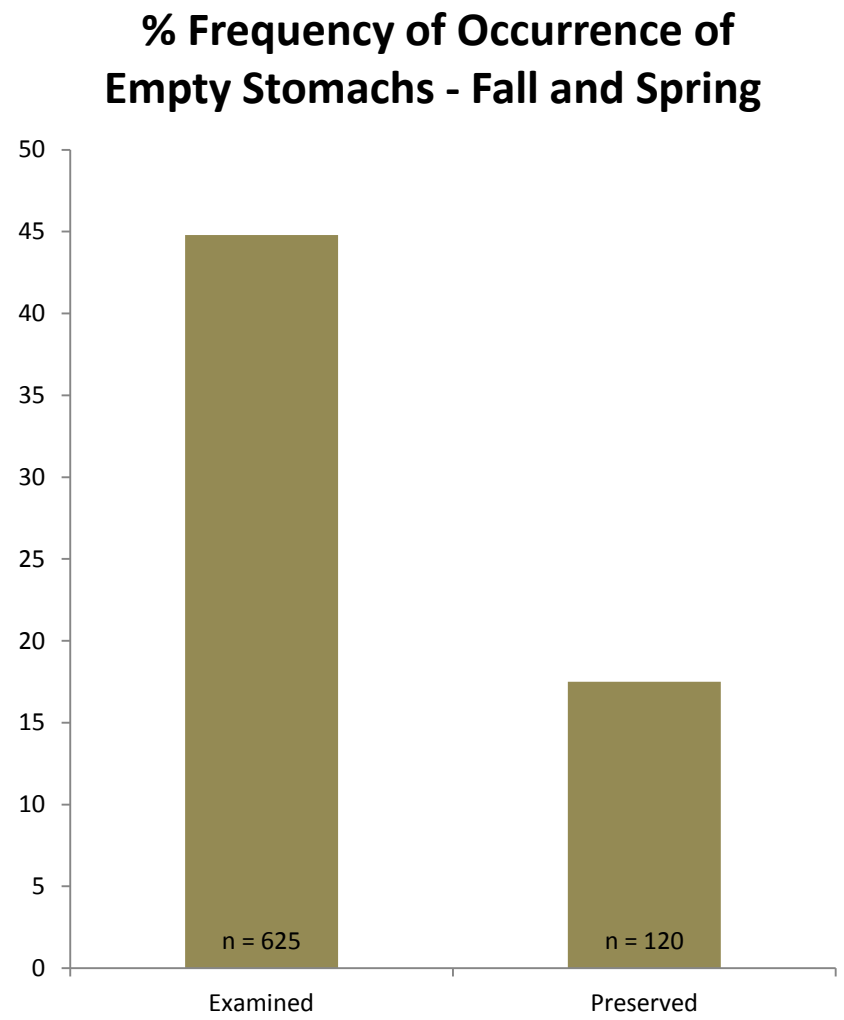
p-value <0.001

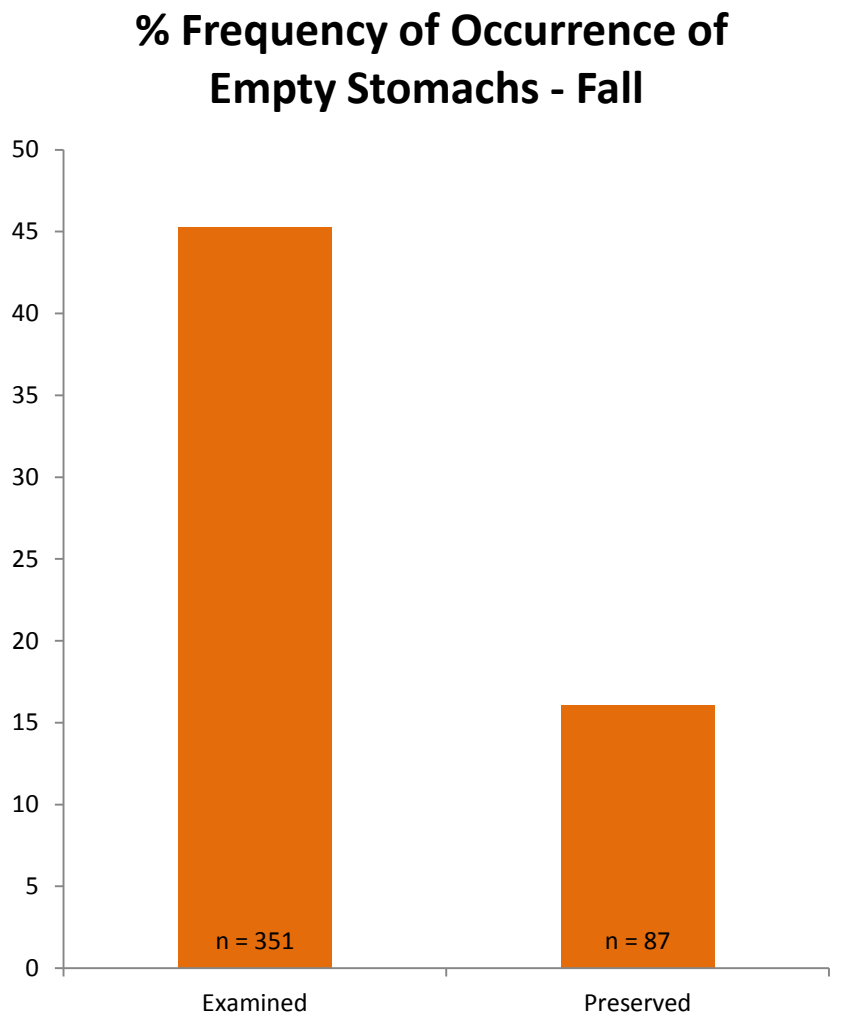
Macro vs Micro Taxonomic Resolution





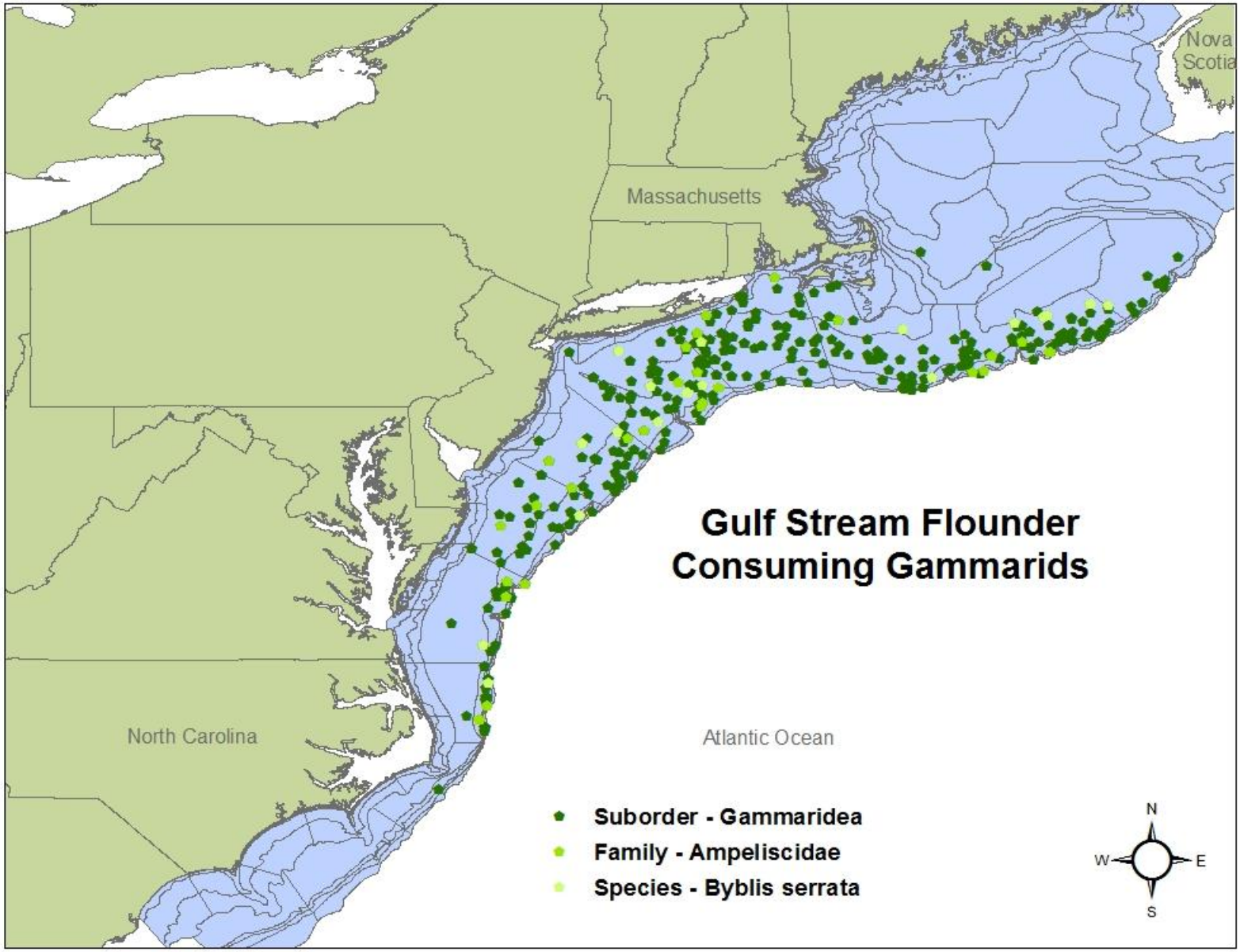
Macro vs Micro Empty Stomachs

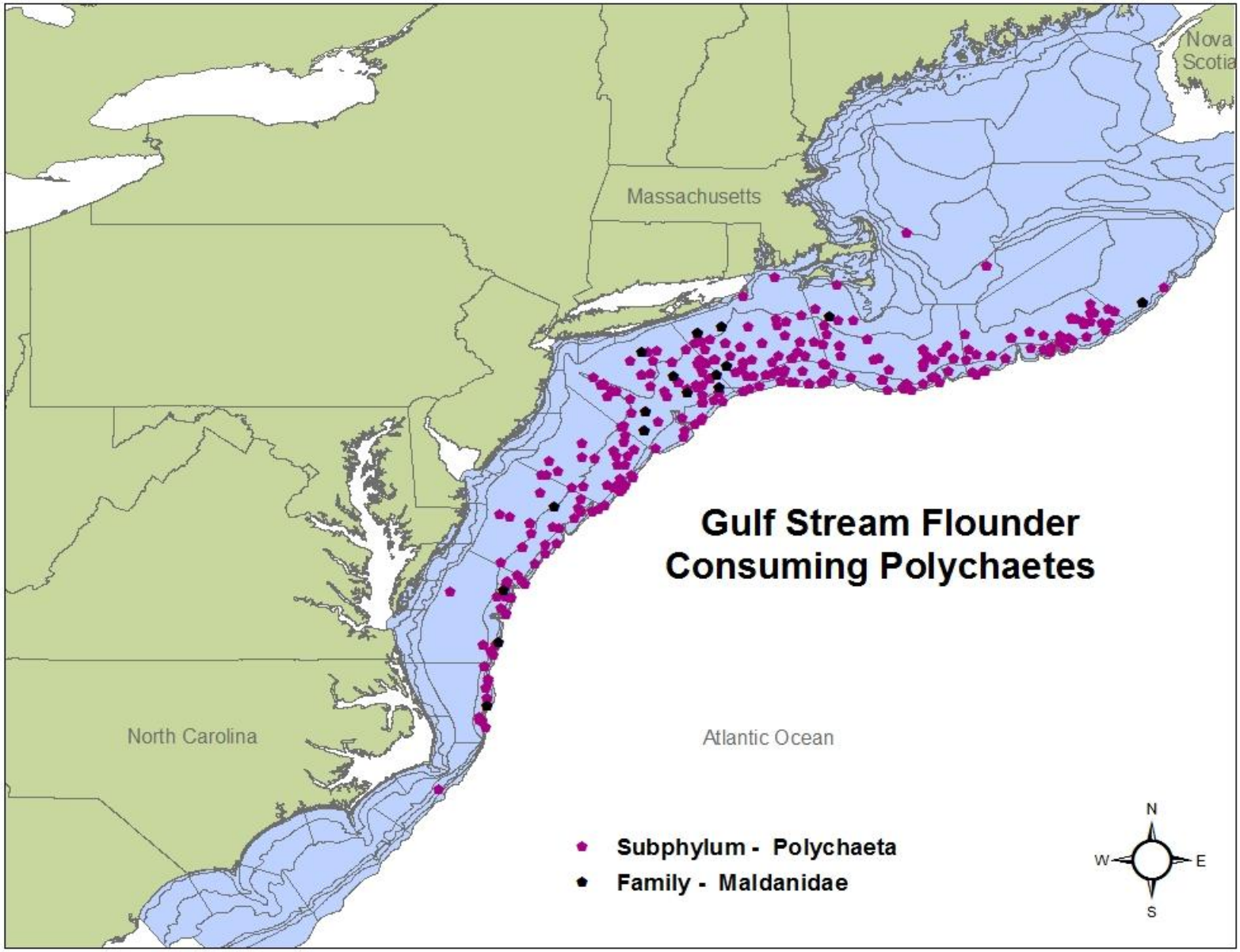


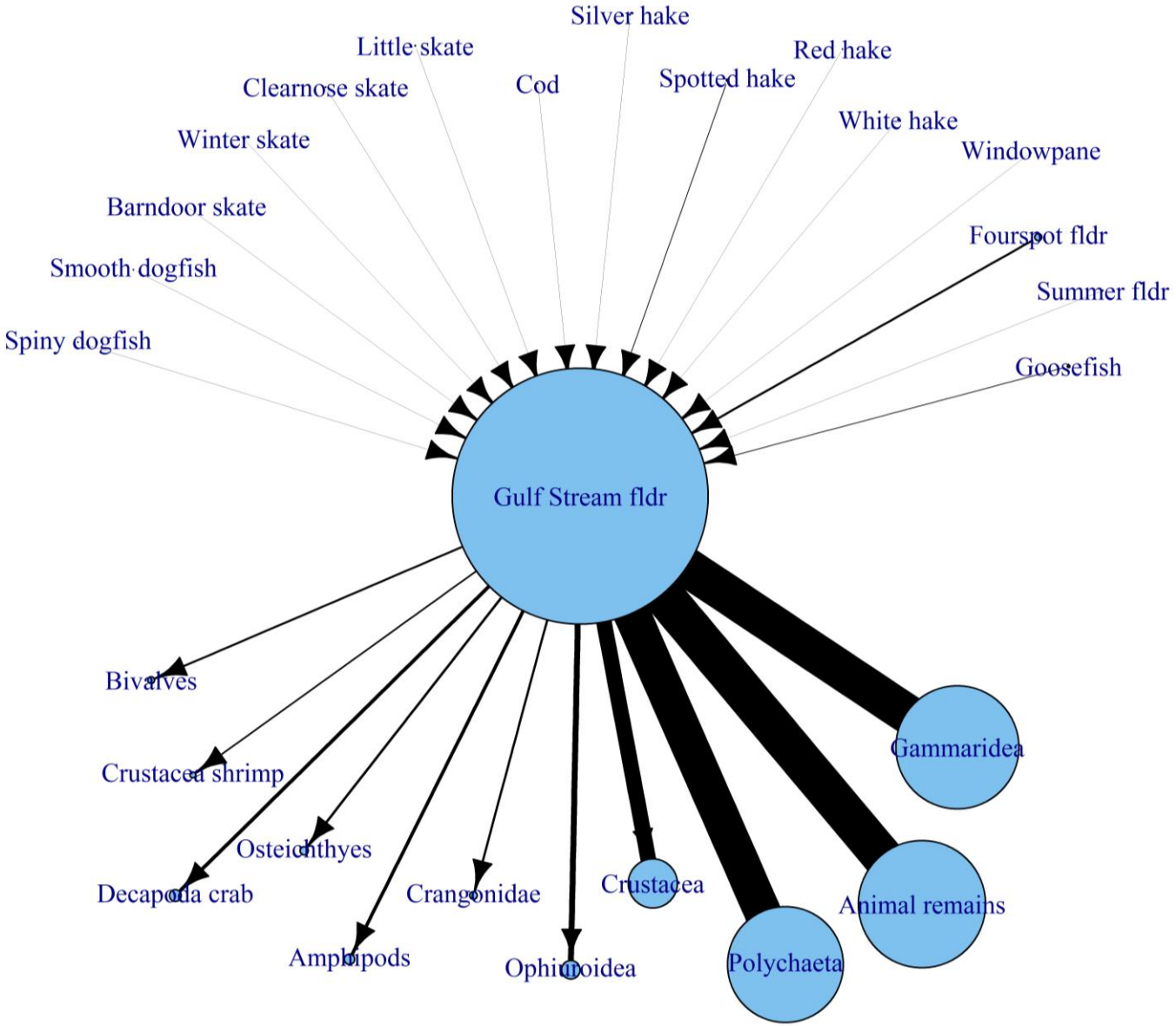


Chi-Square: p-value = <0.001

p-value = <0.001


Nova Scotia
Massachusetts
North Carolina
Atlantic Ocean
Gulf Stream Flounder
Consuming Gammarids
Suborder - Gammaridea
Family - Ampeliscidae
Species - Byblis serrata
N
W
E
S


Nova Scotia
Massachusetts
North Carolina
Atlantic Ocean
Gulf Stream Flounder
Consuming Polychaetes
Subphylum - Polychaeta
Family - Maldanidae
N
W
E
S


Silver hake
Little skate
Red hake
Clearnose skate
Cod
Spotted hake
White hake
Winter skate
Windowpane
Barndoor skate
Fourspot fldr
Smooth dogfish
Summer fldr
Spiny dogfish
Goosefish
Gulf Stream fldr
Bivalves
Gammaridea
Crustacea shrimp
Osteichthyes
Decapoda crab
Crangonidae
Crustacea
Animal remains
Amphipods
Ophiuroidea
Polychaeta

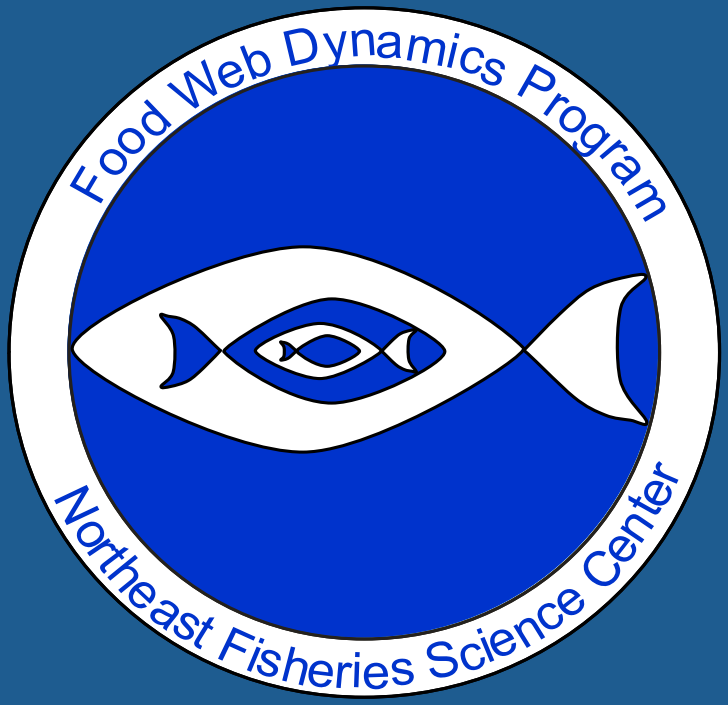
Conclusions

- Gulf Stream are consumed by a wide # of predators on the shelf.
- Gammarids, polychaetes, and various shrimps are important prey.
- Diets were consistent by season and region.
  - Except, brittle stars which were more prominent in stomachs of Southern New England in the spring.
- Annual trends primarily due to taxonomic resolution being higher in lab.

Conclusions

- Taxonomic resolution and mass precision were greater in the lab, but diets were similar.
- Fewer empty stomachs & more accurate volume estimates in-lab suggests microscopic examination is best.
- Gulf Stream lack commercial value, but may prove to be novel samplers of small benthic macrofauna.

Thank You!



http://www.nefsc.noaa.gov/femad/pbb/fwdp/